Il progetto Europeo K4CARE (Knowledge-Based HomeCare eServices for an Ageing Europe): un sistema intelligente per l'assistenza domiciliare all'anziano

F. Campana*, P. Mecocci**,R. Annicchiarico***, S. Ercolani**, D. Amici*, A. Federici***, D. Riaño****, L. Lhotska*****, C. Caltagirone*** *for the K4CARE Researchers.*

CAD RM B, Rome – Italy; Geriatric Dept. Univ. Perugia, Perugia, Italy**; IRCCS S. Lucia, Rome, Italy***; Universitat Rovira i Virgili, Tarragona – Spain****;Czech Technical University in Prague, Prague – Czech Republic*****.*

ABSTRACT. The K4CARE project (FP6-IST-4 IST-2004-026968) is a EC project about the development, integration and use of several Information and Communication Technologies (ICT) and intelligent Computer Science (CS) technologies in the framework of Home Care (HC). The main objective of the K4CARE project is to improve the capabilities of the new EU society to manage and respond to the needs of the increasing number of senior population requiring a personalized HC assistance. K4CARE will develop: a model for HC service which can be shared by the EU countries; an Electronic Home Care Record; a telematic and knowledge-based CS platform; a multi-agent system; Actor Profile Ontologies for representing the profiles of the subjects involved in the K4CARE model; Case Profile Ontologies for representing symptoms, diseases, syndromes; Formal Intervention Plans. The K4CARE project is developed by thirteen EU partners: eight centres with geriatric, medical and healthcare competencies and five ICT and CS centres.

KEYWORDS: Home Care; ICT; Electronic Health Record; Medical Ontologies; Multi Agent System.

Contact: Fabio Campana, MD, PhD fcampana@tiscali.it.

INTRODUCTION. The K4CARE project[1] (FP6-IST-2004-026968) is an European Community project about the development, integration and use of several Information and Communication Technologies (ICT) and intelligent Computer Science (CS) technologies in the framework of Home Care (HC). Since no medical act can be appropriately performed without reliable information, appropriate sharing of patient's information and patient monitoring are basic pre-requisites in delivering effective *continuous care* in home care environments. K4CARE proposes a "patient focused" approach, designed to be translated to a pan-European level, with respect to the principles proposed by WHO to face the chronic diseases epidemic[2]. The use of KDD techniques connected to DSS based on existing guide lines (GL) and interacting with large databases of real patients (sources of evidence and knowledge), will develop a system of producing Evidence Based Practice (EBP) and Formal Intervention Plans (FIPs).

BACKGROUND. The elderly population needing full time care is considered as equivalent to the percentage of severely disabled elderly, which on turn is estimated to be 5% for the 65-69 year-old age group, 10% for the 70-79 age group, and 30% for the 80 and over age group[3]. This population can sum up to ten million people in the EU 25 area[4]. Age-related illnesses - and related dependency - require long-term care. As a result, there is an increase in the pressure on the public sector for long-term care. Hospitalisation – when not related to acute medical conditions, but to the need for rehabilitation or for social support – is both inappropriate and costly. The need of *continuous care* is not a matter for the "conventional" health system, but for the medical-social sector and specific measures will have to be taken. The factors related to how provision is organised are crucially important. In all probability, the only viable path is to assign the role of "small institutions of *continuous care*" to people's own homes, given the possibility to assure them the adequate structures and services. HC has been considered as a fundamental component of a network of long term care facilities (paralleled by rehabilitation units, nursing facilities). HC is conceived as the integration of medical, social and familiar resources addressed to the same goal of allowing the care of the patient in his own environment. Preventive home visitation programs appear to be effective[5], reduce mortality and admission to long term institutional care[6], have a significant impact on hospitalization and are cost-effective[7]. Normative GL can provide the mechanism to link patient outcomes to the care provided and improve quality without increasing costs[8]. However, few GL have been developed for the homecare setting. Existing GL should be modified to be applicable in homecare[9]. Special issues in generating and modifying GL in home care patients are represented by co-morbidity and

reliability of GL related to elderly patients[10]. Several principles of high-quality chronic care have been outlined in the context of a chronic care model[11,12]. This model endorses reliance on multidisciplinary teams of health care professionals and individually tailored evidence-based treatment plans to guide clinical decision making and the frequency of patients' planned visits. Case management is a popular approach to meeting the special needs of medically complex individuals with chronic disease. Case management typically identifies high-risk individuals, regardless of specific conditions, and takes a more comprehensive and customized approach to coordinating all of their health care needs. The typical HC Patient (HCP) is an elderly patient, with co-morbid conditions and diseases, cognitive and/or physical impairment, functional loss from multiple disabilities, impaired self-dependency. To this patient, it is not useful to apply a "vertical" approach, as to say, it is not effective to organize HC as a series of services focused on single diseases, but HC has to be carried out as a network of coordinated interventions: from a vertical disease-related to a holistic function-related care. Although novel models of chronic care have achieved varying levels of success, thus far most of these new approaches have focused on a single disease, a single site, a single transition, or single provider. Rarely more than two of these innovations have been integrated into comprehensive, coordinated systems of care. Moreover, these models commonly operate independently rather than in conjunction with primary care[13]. According to Mary E. Tinetti "The need to ascertain and incorporate individual priorities, to address multiple contributing factors simultaneously, and to prescribe and monitor multifaceted interventions will make clinical decision making more iterative, interactive, individualized, and complex. Creative use of information technologies should facilitate the organization, presentation, and integration of this information to arrive at individualized yet systematic clinical decision making predicated on individual patient priorities."[14] A major role can be played by information in evidence-based practice (EBP): ICT can contribute to establish a broader perspective for EBP. The use of Knowledge Discovery in Data (KDD) techniques connected to Decision Support Systems (DSS) based on existing GL and interacting with large databases of real patients (sources of evidence and knowledge) will develop a system of producing EBP and FIPs that go beyond the well-established paradigm of research, clinical trials, and systematic literature

review[15] – highly time and resource consuming – to generate a knowledge-base that could be a reference in the field of HC.

PROJECT OBJECTIVES. The main objective of the K4CARE project is to improve the capabilities of the new EU society to manage and respond to the needs of the increasing number of senior population requiring a personalized HC assistance. The project will capture and integrate the information, skills, expertises, and experiences of specialised centres and professionals of several old and new EU countries, and will incorporate them in an intelligent web platform in order to provide e-services to health professionals, patients, and citizens in general.

To achieve this goal, the members of the project will provide the scientific and technical knowledge, develop the intelligent technologies to manage that knowledge, supply the ICT infrastructure for anticipating and hastening the medical assistance, implement a web-based platform to approach these technologies to healthcare professionals, patients, and citizens, and assess the platform services in a scenario of combined old and new EU healthcare institutions.

In particular, K4CARE will develop:

1. a model for HC service which can be shared by the EU countries. The model will indicate: the actors involved in the care of the patient (physicians, nurses, social workers, rehabilitative professionals, patient relatives, patients, and citizens in general); their professional liabilities; the services provided; procedures for the service performance and delivering; means, instruments, and modalities of multidimensional evaluation; method for organizing services accessory to the basic HC.

2. An electronic health record (Electronic Home Care Record: EHCR), specifically designed and realized to be used in HC settings. This EHCR will integrate different data types (e.g. text, numerical values, multimedia parts) and documents coming from different sources (e.g. hospital services, laboratories, consultations, specialists, relatives and patients at home).

3. A telematic and knowledge-based CS platform that implements the above model. It will assist all the human actors involved in the care of HCPs. The platform will be tested on west (Italy, UK) and east (Czech Rep., Romania, Hungary) EU societies through pilot tests in order to highlight their differences and also to pursue a convergence to a homogeneous way-

of-doing, contributing to a unique European HC ICT approach. A multi-agent system will allow users to access the EHCR (through a personalized access), edit, adapt, and merge ontologies, and introduce and induce FIPs and will provide e-services to care-givers, patients and citizens (e.g. scheduling of prolonged clinical treatments, intelligent decision support, intelligent distribution of data among users). Those services will be delivered through the Internet and the mobile telephony in a safe, everywhere, anytime way.

4. Actor Profile Ontologies (APO) for representing the profiles of the subjects involved in the K4CARE model: healthcare professionals, patients and relatives, citizens, and social organisms. APOs contain the skills, concerns, aspirations, etc. of the people that they represent, together with the healthcare services that those people offer to or receive from the K4CARE model.

5. Case Profile Ontologies (CPO) for representing symptoms, diseases, syndromes, case mix. Developed technologies for merging prototypic CPOs will be used to have CPOs adjusted to the individual condition of the patient.

6. Formal Intervention Plans for a number of diseases and syndromes. These FIPs will be generated from the information deriving from the available evidence-based guidelines. These FIPs will guide the services the system offers to the professional users. In other words, FIPs are the explicit expressions of how HC must be provided. FIPs will be inductively learned from the EHCR with the use of new machine learning techniques. These techniques must be developed and tested in the domain of HCPs. They are learned from the procedures regarding past patients stored in the system.

The K4CARE project is developed by thirteen EU partners: eight centres with geriatric, medical and healthcare competencies (Centro Assistenza Domiciliare Azienda Sanitaria Locale RM B – Italy – medical management; Geriatric Department of University of Perugia – Italy; Ana Aslan International Academy of Aging – Romania; IRCCS Fondazione Santa Lucia – Italy; The Research Institute for the Care of the Elderly –

UK; General University Hospital in Prague - Czech Republic; Szent Janos Hospital – Hungary; Amministrazione Comunale di Pollenza – Italy) and five ICT and CS centres (Universitat Rovira i Virgili – Spain – coordinator; Czech Technical University in Prague – Czech Republic – technical management; Telecom Italia S.p.A. – Italy; European Research and Project Office GmbH – Germany; Computer and Automation Research Institute of the Hungarian Academy of Sciences – MTA SZTAKI – Hungary). The project is a three year project with starting date on March, 1st 2006.

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